KDS Legato 950 OEM Series

USER'S MANUAL

kdScientific

www.kdscientific.com

KDS Legato 950 OEM Series User's Manual

Table of Contents

KDS Legato 950 OEM Series *User's Manual*

General Information

SAFETY INFORMATION

Please read the following safety precautions to ensure proper use of your syringe pump. If the equipment is used in a manner not specified, the protection provided by the equipment may be impaired.

To Prevent Hazard or Injury:

USE PROPER POWER SUPPLY

The pump is supplied with an approved power supply and line cord. To maintain the safety integrity of the device, use only the following power supplies:

Cui Inc.		**Globtek Inc.**	
Model:	3A – 242DB24	Model:	GT–41062–T3
Output:	24V – 1.0A	Output:	24V – 0.75A
Input:	100–240V ˷50–60 Hz 0.8A	Input:	100–240V ˷50–60 Hz 0.6A

USE PROPER LINE CORD

Use only the specified line cord for this product and make sure line cord is certified for country of use. The operating voltage range for the KDS Legato 950 OEM Series is 12-30 VDC. The universal power supply operating voltage range is 100-240 VAC, 50-60 Hz.

GROUND THE PRODUCT

This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making any connections to the input or output terminals of the product, ensure that the product is properly grounded.

MAKE PROPER CONNECTIONS

Make sure all connections are made properly and securely. Any signal wire connections to the unit must be no longer than 3 meters.

OBSERVE ALL TERMINAL RATINGS

Review the operating manual to learn the ratings on all connections.

AVOID EXPOSED CIRCUITRY

Do not touch any electronic circuitry inside of the product.

AVOID PINCH HAZARD

A pinch hazard may exist between the pusher block and end blocks. Avoid placing fingers between these points while the pump is running.

DO NOT OPERATE WITH SUSPECTED FAILURES

If damage is suspected on or to the product do not operate the product. Contact qualified service personnel to perform inspection.

ORIENT THE EQUIPMENT PROPERLY

Do not orient the equipment so that it is difficult to operate the disconnection device.

PLACE PRODUCT IN PROPER ENVIRONMENT

Review the operating manual for guidelines for proper operating environments.

OBSERVE ALL WARNING LABELS ON PRODUCT

Read all labels on product to ensure proper usage.

CAUTION
Refer to Manual

Protective Ground
Terminal

KDS Legato 950 OEM Series *User's Manual*

WARRANTY AND REPAIR INFORMATION

⚠️ **CAUTION:** REFER TO SAFETY INFORMATION AND SETTING UP THE KDS Legato 100 Series BEFORE PLUGGING IN THE PUMP.

Manual Description

This manual is designed to provide all operational and program information required to operate and maintain the KDS Legato 950 OEM Module. The functions and features are described in the Technical Specifications section.

Warranty

KD Scientific warranties this instrument for a period of one year from date of purchase. At its option, KD Scientific will repair or replace the unit if it is found to be defective as to workmanship or materials. This warranty does not extend to damage resulting from misuse, neglect or abuse, normal wear and tear, or accident. This warranty extends only to the original consumer purchaser.

IN NO EVENT SHALL KD SCIENTIFIC BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you. **THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR USE, OR OF ANY OTHER NATURE**. Some states do not allow this limitation on an implied warranty, so the above limitation may not apply to you.

If a defect arises within the warranty period, promptly contact **KD Scientific, 84 October Hill Road, Holliston, Massachusetts 01746** at 1–508-429-6809. Email address is info@kdscientific.com. Goods will not be accepted for return unless an RMA (returned materials authorization) number has been issued by our customer service department. The customer is responsible for shipping charges for non-warranty repairs. Please allow a reasonable period of time for completion of repairs or replacement. If the unit is replaced, the replacement unit is covered only for the remainder of the original warranty period dating from the purchase of the original device.

This warranty gives you specific rights, and you may also have other rights which vary from state to state.

Repair Facilities and Parts

KD Scientific stocks replacement and repair parts. When ordering, please describe parts as completely as possible, preferably using a part number obtained from our Customer Service department. If practical, enclose a sample part or sketch. We offer a complete reconditioning service.

Serial Numbers

All inquiries concerning our product should refer to the serial number of the unit, located on the rear panel.
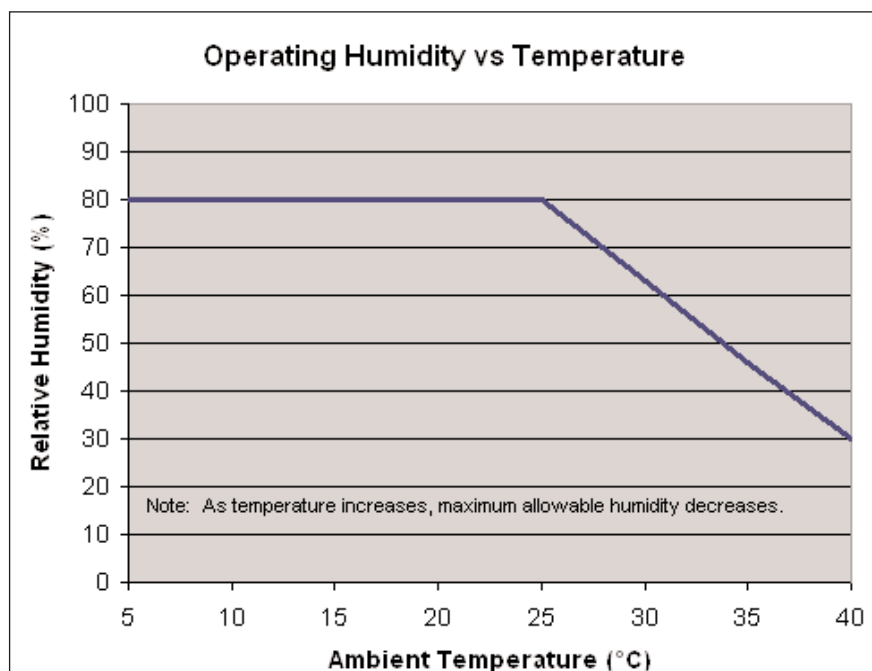
Calibrations

All electrical apparatus are calibrated at rated voltage and frequency. While the flow and volume will stay calibrated, the peak pressure may vary. KD Scientific recommends an annual calibration of the pump.

⚠️ **CAUTION:** For research use only. Not for clinical use on patients.

Specifications	Legato OEM Single, Dual	Legato OEM Pico
Accuracy	± 0.5%	± 0.35%
Reproducibility	± 0.05%	± 0.05%
Syringes (Min./Max.)	0.5 µl / 60 ml (10 ml dual)	0.5 µl / 10 ml
Flow Rate:		
Minimum (0.5 µl syringe)	1.26000 pl/min	0.54000 pl/min
Maximum (10 ml syringe)	26.0170 ml/min	11.7027 ml/min
Maximum (60 ml syringe)	88.4040 ml/min	N/A
Non-Volatile Memory	Stores all settings	Stores all settings
Connectors:		
RS-485	IEEE-1394, 6 pos	IEEE-1394, 6 pos
USB	Type B	Type B
I/O & TTL	15 pin D-Sub Connector	15 pin D-Sub Connector
Footswitch	mini phone jack	mini phone jack
Linear Force (Max)	13.6 kg (30 lbs) @ 100% Force Selection	13.6 kg (30 lbs) @ 100% Force Selection
Drive Motor	0.9° Stepper Motor	0.9° Stepper Motor
Motor Drive Control	Microprocessor with 1/16 microstepping	Microprocessor with 1/16 microstepping
Number of Microsteps per one rev. of Lead Screw	15,360	20,480
Step Resolution	0.069 µm/µstep	0.031 µm/µstep
Step Rate:		
Minimum	27.5 sec/µstep	27.5 sec/µstep
Maximum	26 µsec/µstep	26 µsec/µstep
Pusher Travel Rate:		
Minimum	0.15 µm/min	0.02 µm/min
Maximum	159.00 mm/min	71.55 mm/min
Input Power	12-30 VDC (24V recommended)	12-30 VDC
Input Power Connection	2.5mm ID x 5.5mm OD male plug	2.5mm ID x 5.5mm OD male plug
Power Supply	100-240 VAC, 50-60 Hz, 8 Watts Universal Power Supply, Use Only a KD Scientific Approved Power Supply and Line Cord	100-240 VAC, 50-60 Hz, 8 Watts Universal Power Supply, Use Only a KD Scientific Approved Power Supply and Line Cord
Dimensions	24.38 x 10.16 x 16.51 cm (9.6 x 4 x 6.5 in)	22.6 x 19.05 x 15 cm (9 x 7.5 x 5 in)
Weight	2.36 kg (5.2 lbs)	2.66 kg (5.9 lbs)

KDS Legato 950 OEM Series *User's Manual*

KDS Legato 950 OEM Series *User's Manual*

Specifications	Legato OEM Single, Dual & Pico
Atmospheric Specifications:	
Operating Temperature	4°C to 40°C (40°F to 104°F)
Storage Temperature	-10°C to 70°C (14°F to 158°F)
Operating Humidity	See Chart Below
Storage Humidity	20% to 80% RH, non condensing
Method of Operation	Continuous
Classification	Class I
Pollution Degree	1
Installation Category	II
Supplier Name	KDS
Supplier Address	84 October Hill Rd., Holliston, MA 01746
Supplier Phone Number	(508) 429-6809
Regulatory Certifications	CE, UL, CSA, CB Scheme, EU RoHS, WEEE
Safety Declarations	ANSI/UL 61010-1:2004 Ed. 2 Rev. 2005; CAN/CSA C22.2 No. 61010-1:2004 Ed. 2; IEC 61010-1:2001 Ed. 2 Corrigendum 1:2002, Corrigendum 2:2003; CENELEC EN 61010-1:2001; CB Scheme
EMC Declaration	IEC 61326-1 Ed. 1

Operating Humidity vs Temperature

Relative Humidity (%) vs Ambient Temperature (°C)

Note: As temperature increases, maximum allowable humidity decreases.

Product Overview

The KD Scientific Legato 950 OEM Series is the next generation of syringe pumps.

An led light on the front panel makes it easy to see if the pump is running.

The pumps are versatile and can be interconnected through the RS485 interface. Legato 950 OEM Series models can be mixed and matched in the daisy chain offering maximum flexibility. Up to 99 pumps can be linked together through the RS485 interface provided each pump is assigned its own unique pump address.

Flow performance is optimized with a small step angle stepping motor that drives a precision lead screw and pusher block. The syringe mechanism is easy to use and securely holds the syringes for smooth flow performance.

Advanced microstepping techniques are employed to further reduce the step angle to eliminate flow pulsation. The accuracy is ±0.5% with 0.05% reproducibility. A wide dynamic flow range can be programmed into the pump. Flow rates are selectable with user selected engineering units from ml, μl, nl pl, and hours, minutes and seconds.

Up to 30 lbs of linear force is available. This force is user adjustable to ensure the right force is applied for the various syringe sizes.

The superior design of the full metal chassis provides noise isolation and anti-vibration features for increased reliability.

Easy external connections to a computer or other control devices are made through USB interface. Simple ASCII commands make communication with the pump easy. For direct control of the pump, the user can use the I/O interface (15pin Dsub). A trigger output and a trigger input in for external events such as a process parameter is met. The footswitch input will allow the control of the pump through an external device. The unit also has an output for run indication allowing connection to a remote light.

Single or dual syringes models are available. Complete flexibility is offered with the user able to use most manufacturer's syringes with sizes ranging from 0.5 ul to 60 ml.

Pump Models

The Legato 950 OEM Series is available in 3 different configurations.
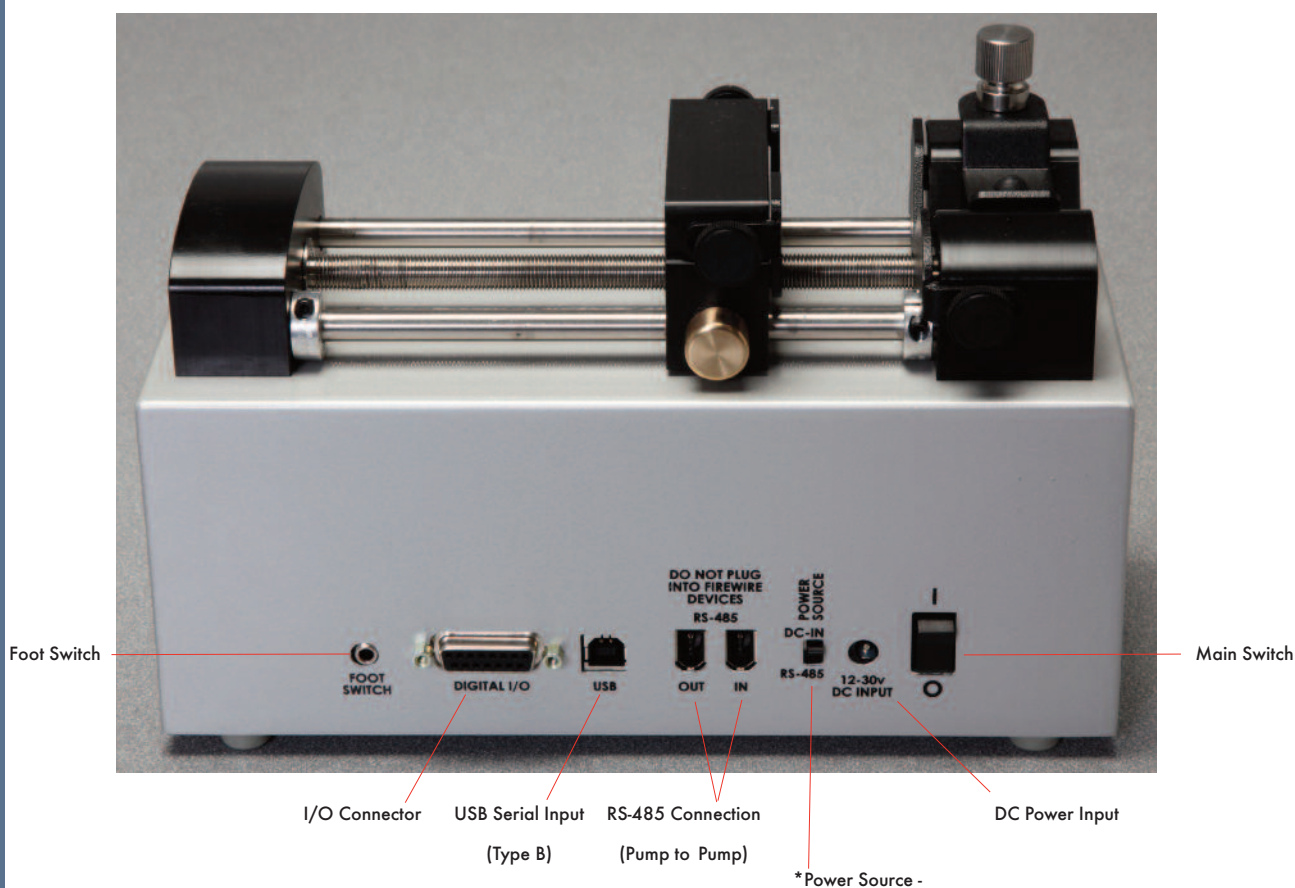
Legato 950 – *Single syringe infuse/withdraw*

Legato 952 – *Dual syringe infuse/withdraw*

Legato 958 – *Dual syringe infuse/withdraw optimized for low flow*

KDS Legato 950 OEM Series User's Manual

OPERATING INSTRUCTIONS

View of the OEM 950 connections

Foot Switch — I/O Connector — USB Serial Input (Type B) — RS-485 Connection (Pump to Pump) — Main Switch — DC Power Input

*Power Source -

When powering a pump in a chain through an RS-485 cable, toggle switch to RS-485. Only one pump can be powered from the master through the RS-485.

POWER CONNECTIONS

1. Plug the power supply into the pump.

2. Connect to a properly rated line cord. The Legato 100 Series power supply has a DC power input connector on the rear of the unit. The operating range for the Legato 950 OEM Series series is 100– 240 VAC, 50-60 Hz.

3. Turn on the main power switch.

⚠️ **CAUTION:** Do not connect to firewire ports on a computer. Damage may occur to the pump or computer.

KDS Legato 950 OEM Series User's Manual

SYRINGE LOADING
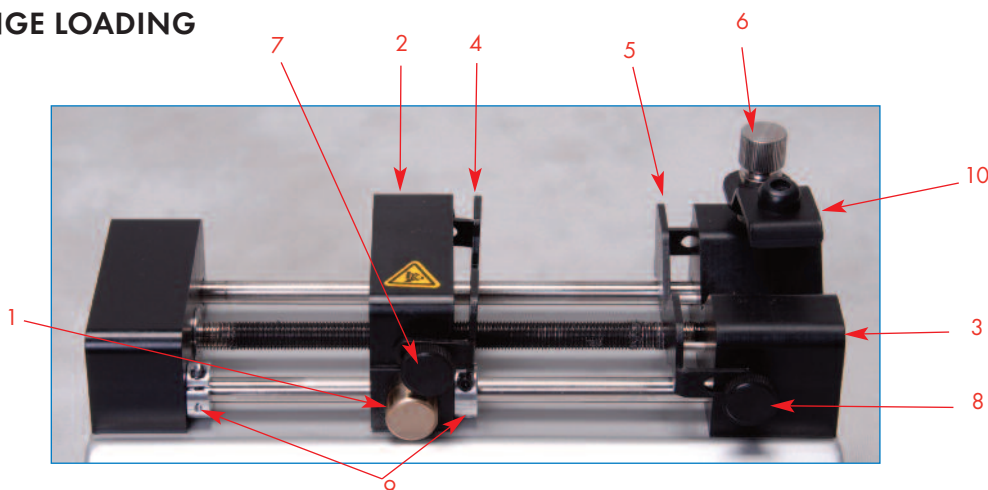
The Legato 950 OEM Series can accommodate up to two syringes. Depending on the mechanism, any type of syringe, glass, plastic or stainless steel can be used. The pump can accommodate from 0.5 µl to 60 ml single syringe and 0.5 µl to 10 ml dual syringe. The syringe barrel clamp should be flipped for syringes smaller than 30 ml. For syringes larger than 30 ml, the syringe clamp should be used as shown.

1. Squeeze the release button (1) and move the pusher block (2) to the approximate length of the syringe.

2. Unscrew the bracket clamping knobs (7,8) to loosen the retaining brackets (4,5) on the pusher block (2) and the syringe holder block (3).

3. Unscrew the syringe barrel clamp (10) by unscrewing the syringe barrel clamp knob (6).

4. Place the syringe on the syringe holder block (3). Ensure the barrel flange is within the syringe holder's block's retaining bracket (5) and the plunger flange is in the pusher block's retaining bracket (4).

5. Screw down the syringe clamp knob (6) until the syringe barrel clamp (10) is tight against the syringe barrel. Do not overtighten, especially when using glass syringes.

6. Secure the syringe flanges by pushing the retaining brackets (4,5) tightly against the syringe flanges using the bracket clamping knobs (7,8). The syringe plunger should be secured by the pusher block retaining bracket and the flange of the syringe should be secured by the syringe holder block retaining bracket.

7. Tighten the mechanical stop collars (9) on the pump to prevent excess pusher block travel.

NOTE: *The syringe barrel clamp (10) [single only] may need to be flipped depending on your syringe size. To do so, completely unscrew and remove the syringe barrel clamp knob from the syringe block. Then remove lock nut (11). Flip the bracket and reassemble.*

NOTE: *Syringe brackets (4 & 5) are only available on Legato 110, 111 & 180.*

> 30 cc syringes

< 30 cc syringes
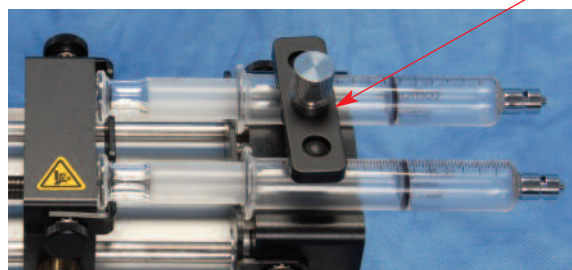
10
Dual Syringe Clamp

CAUTION: Be sure mechanical stop collars are positioned properly to prevent the plunger from bottoming out on glass syringes.

NOTE: *For infuse/withdraw models, make sure the plunger is secured in the retaining bracket and the barrel of the syringe is secured in the retaining bracket.*

EXTERNAL PUMP CONTROL

This section of the KDS Legato 950 OEM Series manual describes the control of the pump using an external computer device. If communicating via the USB Port, see Appendix C for one time installation instructions of USB Driver.

> **NOTE:** *The KD Scientific Pump Terminal Program , provided on the Legato CD, can be used for easy external control of the Syringe Pump via USB connection.*

Setting Up HyperTerminal

HyperTerminal is a Windows application designed to support the external control of devices such as the KDS Legato 950 OEM Series pump through a USB connection. The following instructions describe the configuration of the HyperTerminal application.

1. Select "Start – All Programs – Accessories – Communications – HyperTerminal".

2. Enter a name for a New Connection (i.e KDS_Legato_100), then click OK.

3. Select the Virtual Comm Port from the "Connect using" drop-down list. Click OK. (If the Virtual Comm Port is not known, use Device Manager to find it. Instructions on setting up the Virtual CommPort Driver are supplied in Appendix C.)
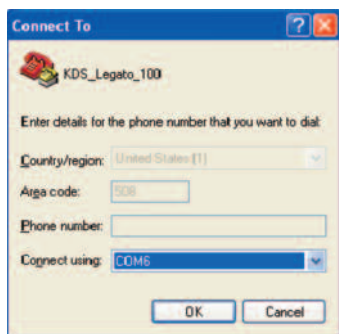
> **NOTE:** *To determine the proper comport, in your PCs "Systems Properties" screen, under the "Hardware" tab, select "Device Manger". Expand the "ports (COM & LPT)" section and you should see "Syringe Pump". The comport is listed next to this in parenthesis.*

4. Set up the Port Settings as shown below and click OK.
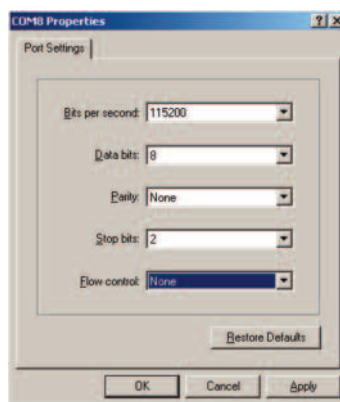
5. Verify the Settings are as shown below.
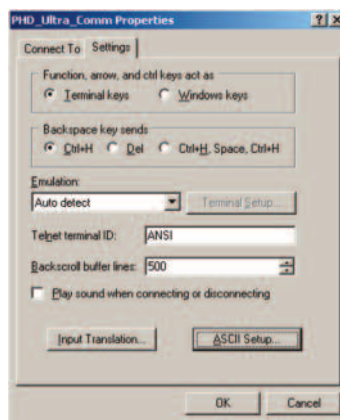
6. Choose ASCII Setup and select "Echo typed characters locally"then click OK to complete the setup.
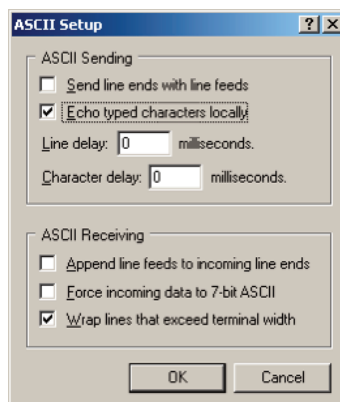
> **NOTE:** *To determine if your pump is connected correctly, in Hyperterminal's main window press 'Enter'; a ':' should appear. If not connected properly, close Hyperterminal, turn off the pump, unplug then re-plug the USB cable and re-open Hyperterminal.*

PUMP CHAIN COMMANDS

The Pump Chain commands allow all pump control information to be managed from an external computer source. These commands can also be used to control a series of pumps (up to 100) from a single computer interface.

KDS Legato 950 OEM Series commands are communicated to the pump via the USB port interfaces through a terminal program such as HyperTerminal. In using the Pump Chain commands, you will need to assign each pump in the pump chain a unique address, using the Set Pump Address command in the Settings menu. The address range is from 00 to 99. This address value is used to identify which pump is to receive a command and which pump is responding. The first pump in the chain, the one connected to the computer, must use address 0 (zero). Configure each pump with its assigned address and baud rate as described in the Pump Settings section of

NOTE: *Once communication is established, if you manipulate the touchscreen, you must reestablish communications to the PC (<CR> will do this)*

NOTE: *System commands and start/stop commands can be executed from program or mode configuration screens. For parameter commands (rate, dia, vol, etc) it is necessary to execute from the Configuration Run screen.*

NOTE: *To maximize communication speed [as fast as 50 ms rate changes]: (a) prefix commands with the @ symbol to turn off GUI updates (ex: @irate 100 u/m) (b) use the 'NVRAM off' command to turn off writes of rate to memory.*

this guide.

Pump Chain Commands

KDS Legato 100 commands are entered via the USB port with a terminal program such as HyperTerm, or by using a controlling computer.

Commands may be abbreviated to the first four letters, i.e. address would be abbreviated addr. A space must follow the command if arguments are included.

Every line of the response from a pump with a nonzero address is prefixed by the two digit pump address (prefixed with a 0 if necessary) followed by a colon. No colon is used to separate the pump address from the prompt however.

In the command list below, the following convention is used:

{ }	Required parameter
[ ]	Optional parameter
|	Separator between parameter choices
#	Numeric value without preceding zeros
###	Numeric value with preceding zeros
#-#	A range of values
<cr>	Carriage return
<lf>	Line feed
<sp>	Space
[prefix]	Pump address prefix in the format #: if the pump address is not zero
<prompt>	Prompt (see below)

The following prompts are returned after a command is executed:

:	The pump is idle
>	The pump is infusing
<	The pump is withdrawing
*	The pump stalled
T*	The target was reached

If the pump is in poll mode, an XON character is added after the prompt.

If the pump address is nonzero, the pump address is prefixed to the prompt without a colon.

In the following list of commands:

The pump address is prefixed to every response line followed by a colon.

<lf>[##]<prompt> is the response unless otherwise noted.

Error messages

Error messages are displayed if the entered command cannot be executed for some reason. The error message will take up two lines with the first line being the message type and the second line describing the error itself. The second line may be up to 80 characters long.

Command errors

Command errors are displayed when the command is unrecognized, entered in the wrong mode, or the state of the pump keeps the command from executing (i.e. using the IRUN command if a limit switch is active).

The command error has the following format:

<lf>[##:]Command error:<cr>

<lf>[##:]<sp><sp><sp>{error message}<cr>

<lf>[##]<prompt>

Argument errors

Argument errors are displayed when a command argument is unrecognized or out of range. The argument in question will be displayed except in the case of missing arguments.

The argument error has the following format:

<lf>[##:]Argument error: [bad argument]<cr>

<lf>[##:]<sp><sp><sp>{error message}<cr>

<lf>[##]<prompt>

System commands

ADDRESS

Sets or displays the pump address. Valid range is 0 to 99.

Command format:

address [0-99]

Query response:

<lf>[##:]Pump address is #<cr>

<lf>[##]<prompt>

NOTE: *Pumps with an address of 0 are masters, and pumps with an address between 1 and 99 are slaves.*

CATALOG

Displays a catalog of programs stored in the pump.

Command format:

cat

Query response:

<lf>[##:]Program name   Size<cr>

<lf>[##:]——————— ——<cr>

<lf>[##:]{program name}   #<cr>
This line is repeated for each file on the disk

<lf><lf>[##:]# file(s) using # steps<cr>

<lf>[##]<prompt>

NOTE: *The file size is the number of steps in the program plus one for the file information header.*

The last line shows the number of files and the total number of steps being used on the disk.

CONFIG

Sets or displays pump configuration.

Command format:

Config [{config designation}|{value}]

NOTE: *After changing the configuration, the pump must be power cycled.*

DELMETHOD

Deletes a program, stored in the pump.

Command format:

delmethod {program}

ECHO

Sets or displays the USB echo state. Valid states are on or off.

Command format:

echo [on|off]

Query response:

<lf>[##:] OFF<cr>

<lf>[##]<prompt>

or:

<lf>[##:] ON<cr>

<lf>[##]<prompt>

FORCE

Sets or displays the infusion force level in percent. Valid range is 1 to 100.

Command format:

force [1-100]

Query response:

<lf>[##:]#%<cr>

<lf>[##]<prompt>

FTSWITCH

Sets or displays the footswitch setting. The footswitch may be used in a toggle on or off mode (momentary), a press to run mode (falling), or a release to run mode (rising).

Command format:

ftswitch [mom|rise|fall]

Query response:

<lf>[##:]Momentary<cr>

<lf>[##]<prompt>

or:

<lf>[##:]Active high<cr>

<lf>[##]<prompt>

or:

<lf>[##:]Active low<cr>

<lf>[##]<prompt>

LOAD

Loads a method.

Command format:

    load

    load {method name}

    load qs {i|w|iw|wi}

Query response:

    <lf>[##:]Quick Start - Infuse Only (qs i)<cr>

    <lf>[##]<prompt>

or:

    <lf>[##:]Quick Start - Withdraw Only (qs w)<cr>

    <lf>[##]<prompt>

or:

    <lf>[##:]Quick Start - Infuse/Withdraw (qs iw)<cr>

    <lf>[##]<prompt>

or:

    <lf>[##:]Quick Start - Withdraw/Infuse (qs wi)<cr>

    <lf>[##]<prompt>

or:

    <lf>[##:]{method name}<cr>

    <lf>[##]<prompt>

POLL

Sets or displays the polling mode state. In polling mode, prompts are inhibited if they aren't generated by a typed command. Valid states are on or off.

Command format:

    poll [on|off]

Query response:

    <lf>[##:]OFF<cr>

    <lf>[##]<prompt>

or:

    <lf>[##:]ON<cr>

    <lf>[##]<prompt>

SYRMANU

Sets or displays the syringe manufacturer. Configuration Run screen mode only. Valid 3-character manufacturer codes are shown in the table below:

air	Air-Tite, HSW Norm-Ject
bdg	Becton Dickinson, Glass (all types)
bdp	Becton Dickinson, Plasti-pak
cad	Cadence Science, Micro-Mate Glass
hm1	Hamilton 700, Glass
hm2	Hamilton 1000, Glass
hm3	Hamilton 1700, Glass
hm4	Hamilton 7000, Glass
hos	Hoshi
kgl	KD Scientific, Glass
ils	ILS, Glass
nip	Nipro
sge	SGE (Scientific Glass Engineering)
smp	Sherwood-Monoject, Plastic
sst	Stainless Steel
tej	Terumo Japan, Plastic
top	Top

Typing 'syrm' with no arguements displays the current syringe setting.

Typing 'syrm ?' displays a list of manufacturers with their associated 3-letter code.

Typing 'syrm {code} ?' shows a list of syringe sizes associated with the specified manufacturer.

Command format:

    syrm [?|{3 char code}?|{volume}ul|ml]

Query response:

    <lf>[##:]{manufacturer}, {diameter} mm<cr>

    <lf>[##]<prompt>

    or:

    <lf>[##:]Custom, {diameter} mm<cr>

    <lf>[##]<prompt>

    or:

    <lf>[##:]{code}, {diameter} mm<cr> (this line is repeated for each syringe manufacturer)

    <lf>[##]<prompt>

    or:

    <lf>[##:]{volume}, {unit}<cr> (this line is repeated for each syringe size)

    <lf>[##]<prompt>

VER

Displays the short version string.

Command format:

    ver

Query response:

    <lf>[##:]KDS Legato 9XX #.#.#<cr>

    <lf>[##]<prompt>

VERSION

Displays the full version string.

Command format:

version

Query response:

<lf>[##:]Firmware: v#.#.#<cr>

<lf>[##:]Pump address: #<cr>

<lf>[##:]Serial number: C ######<cr>

<lf>[##:]Device ID: ########<cr>

<lf>[##]<prompt>

Run commands

IRUN

Runs the pump in the infuse direction. Configuration Run screen mode only.

Command format:

irun

RRUN

Runs the pump in the opposite direction. Configuration Run screen only.

Command format:

rrun

RUN

Simulates a key press of the run button located in the lower right corner of the screen.

Command format:

run

STOP / STP

Stops the pump.

Command formats:

stop

stp

WRUN

Runs the pump in the withdraw direction. Configuration Run screen mode only.

Command format:

wrun

Rate commands

CRATE

Displays the current rate that the motor is running at. A valid response is returned only in dynamic situations (if the motor is running). Configuration Run screen mode only.

Command format:

crate

Query response:

<lf>[##:]Infusing at # xl/xxx<cr>

<lf>[##]<prompt>

or:

<lf>[##:]Withdrawing at # xl/xxx<cr>

<lf>[##]<prompt>

DIAMETER

Sets or displays the syringe diameter in mm. Configuration Run screen mode only.

Command format:

diameter [{syringe diameter}]

Query response:

<lf>[##:]#.#### mm<cr>

<lf>[##]<prompt>

IRAMP

Sets or displays the infusion rates while ramping. Configuration Run screen mode only.

Command format:

iramp [{start rate} {start units} {end rate} {end units} {ramp time in seconds}]

Query response:

<lf>[##:]Ramp not set up.<cr>

<lf>[##]<prompt>

or:

<lf>[##:]# xl/xxx to xl/xxx in # seconds<cr>

<lf>[##]<prompt>

IRATE

Sets or displays the infusion rate. Configuration Run screen mode only. The rate argument may be replaced by "max" or "min" to set the maximum or minimum rate, respectively. "lim" may be used to display the range limits.

Command format:

irate [max|min|lim|{rate} {rate units}]

Query response:

<lf>[##:]# xl/xxx<cr>

<lf>[##]<prompt>

or:

<lf>[##:]# xl/xxx to # xl/xxx<cr>

<lf>[##]<prompt>

WRAMP

Sets or displays the withdraw rates while ramping. Configuration Run screen mode only.

Command format:

wramp [{start rate} {end rate} {rate units} {ramp time in seconds}]

Query response:

<lf>[##:]Ramp not set up.<cr>

<lf>[##]<prompt>

or:

<lf>[##:]# xl/xxx to xl/xxx in # seconds<cr>

<lf>[##]<prompt>

NOTE: *To clear a ramp, use CTTIME command.*

WRATE

Sets or displays the withdraw rate. Configuration Run screen mode only. The rate argument may be replaced by "max" or "min" to set the maximum or minimum rate, respectively. "lim" may be used to display the range limits.

Command format:

wrate [max|min|lim|{rate} {rate units}]

Query response:

<lf>[##:]# xl/xxx<cr>

<lf>[##]<prompt>

or:

<lf>[##:]# xl/xxx to # xl/xxx<cr>

<lf>[##]<prompt>

Volume commands

CIVOLUME

Clears the infused volume. Configuration Run screen mode only.

Command format:

civolume

CTVOLUME

Clears the target volume. Configuration Run screen mode only.

Command format:

ctvolume

CVOLUME

Clears both the infused and withdrawn volumes. Configuration Run screen mode only.

Command format:

cvolume

CWVOLUME

Clears the withdrawn volume. Configuration Run screen mode only.

Command format:

cwvolume

IVOLUME

Displays the infused volume. Configuration Run screen mode only.

Command format:

ivolume

Query response:

<lf>[##:]# xl<cr>

<lf>[##]<prompt>

SVOLUME

Sets or displays syringe volume. Configuration Run screen mode only.

Command format:

svolume

Query response:

<lf>[##:]#.####ul<cr>

<lf>[##]<prompt>

or:

<lf>[##:]#.#### ml<cr>

<lf>[##]<prompt>

TVOLUME

Sets or displays the target volume. Configuration Run screen mode only.

Command format:

tvolume [{target volume} {volume units}]

Query response:

<lf>[##:]Target volume not set<cr>

<lf>[##]<prompt>

or:

<lf>[##:] # xl<cr>

<lf>[##]<prompt>

WVOLUME

Displays the withdrawn volume. Configuration Run screen mode only.

Command format:

wvolume

Query response:

<lf>[##:]# xl<cr>

<lf>[##]<prompt>

Time commands

CITIME

Clears the infused time. Configuration Run screen mode only.

Command format:

citime

CTIME

Clears both the infused and withdrawn times. Configuration Run screen mode only.

Command format:

ctime

CTTIME

Clears the target time. Configuration Run screen mode only.

Command format:

cttime

CWTIME

Clears the withdrawn time. Configuration Run screen mode only.

Command format:

cwtime

ITIME

Displays the infused time. Configuration Run screen mode only.

Command format:

itime

Query response:

<lf>[##:]# seconds<cr>

<lf>[##]<prompt>

or:

<lf>[##:]##:##:##<cr>

<lf>[##]<prompt>

TTIME

Sets or displays the target time. Configuration Run screen mode only.

Command format:

ttime [{target time}]

Query response:

<lf>[##:]Target time not set<cr>

<lf>[##]<prompt>

or:

<lf>[##:]# seconds<cr>

<lf>[##]<prompt>

or:

<lf>[##:]##:##:##<cr>

<lf>[##]<prompt>

WTIME

Displays the withdrawn time. Configuration Run screen mode only.

Command format:

wtime

Query response:

<lf>[##:]# seconds<cr>

<lf>[##]<prompt>

or:

<lf>[##:]##:##:##<cr>

<lf>[##]<prompt>

Digital I/O commands

INPUT

Reads and displays the trigger input port status.

Command format:

    input

Query response:

    <lf>[##:]Low.<cr>

    <lf>[##]<prompt>

or:

    <lf>[##:]High.<cr>

    <lf>[##]<prompt>

OUTPUT

Sets the level on one of the output ports.

Command format:

    output {1} {high|low}

SYNC

Sets the level on the sync port.

Command format:

    sync {high|low}

Internal commands

STATUS

Displays the raw status for use with a controlling computer.

Command format:

    status

The output is in three integer fields and one flag field, all separated by spaces and terminated by a carriage return / linefeed pair. The first integer is the current rate in femtoliters per second. The second integer is the infuse time in milliseconds. The time has a granularity of 1 millisecond. The third integer is the infused volume in femtoliters. All three values are for the current direction.

The flag field consists of six flags.

- Flag one is the motor direction and will be "i or I" if the pump is infusing and "w or W" if the pump is withdrawing. If the letter is lower case, the pump motor is idle. If upper case, the pump motor is running.

- Flag two is the limit switch status. If the infuse limit switch was hit, "i or I" is displayed. If the withdraw limit switch was hit, "w or W" is displayed. If no limit switch was hit or the pump does not have limit switches, "." Is displayed.

- Flag three is the stall status and will be "S" if the pump has stalled. Otherwise it will be ".".

- Flag four is the trigger input state and will be "T" if high and "." if low.

- Flag five is the direction port state and will be "I" for infuse and "W" for withdraw.

- Flag six is the target reached status. It will be "T" if the target time or volume was reached and "." if not.

Appendices

APPENDIX A: SYRINGE VOLUME/DIAMETER REFERENCE TABLE

KD Scientific Stainless Steel

Size	Diameter
2.5 ml	4.851 mm
8	9.525
20	19.13
50	28.6

Air–Tite HSW Norm-Ject

Size	Diameter
1 ml	4.69 mm
2.5	9.65
5	12.45
10	15.9
20	20.05
30	22.9
50	29.2

Becton Dickinson 'Plasti-pak'

Size	Diameter
1 ml	4.699 mm
3	8.585
5	11.989
10	14.427
20	19.05
30	21.59
50	26.594
60	26.594

Terumo Japan

Size	Diameter
1 ml tb	4.7 mm
1 ml vc	6.5 mm
2.5	9.0
5	13.0
10	15.8
20	20.2
30	23.2
50	29.2

SGE Scientific Glass Engineering

Size	Diameter
5 µl	0.343 mm
10	0.485
25	0.728
50	1.03
100	1.457
250	2.303
500	3.257
1 ml	4.606 mm
2.5	7.284
5	10.301
10	14.567
25	23
50	27.5

Hamilton Glass - All Types

Size	Diameter
0.5 µl	0.103 mm
1	0.1457
2	0.206
5	0.330*
5	0.343**
10	0.485**
10	0.461***
25	0.729
50	1.03
100	1.457
250	2.304
500	3.256
1 ml	4.608 mm
1.25	5.151
2.5	7.285
5	10.3
10	14.567
25	23.033
50	32.573

*= Series 7000
** = Series 700
*** = Series 1700

Cadence Science, Inc.
Formerly Popper & Sons
MICRO-MATE Glass

Size	Diameter
0.25 ml	3.47 mm
0.5	3.62
1	4.82
2	8.91
3	8.91
5	11.71
10	14.65
20	19.56
30	22.7
50	28.02

Becton Dickinson Glass-All Types

Size	Diameter
0.5 ml	4.64 mm
1	4.64
2.5	8.66
5	11.86
10	14.34
20	19.13
30	22.7
50	28.6

KD Scientific Glass

Size	Diameter
1 ml	4.80 mm
2	6.45
5	12.60
10	15.50
20	20.40
30	22.90
50	27.45

ILS Glass

Size	Diameter
250 µl	2.303 mm
500	3.260
1 ml	4.606 mm
2.5	7.280
5	10.300
10	14.567
25	23.032
50	32.573

Sherwood–Monoject Plastic

Size	Diameter
1 ml	4.674 mm
3	8.865
6	12.600
12	15.621
20	20.142
35	23.571
60	26.568

Hoshi

Size	Diameter
1 ml	6.50 mm
2	9.10
3	10.00
5	12.60
10	15.10
20	20.45
30	22.50
50	25.60

Top

Size	Diameter
1 ml	6.40 mm
2.5	9.30
5	13.10
10	15.3
20	21.0
30	23.0
50	29.0

Nipro

Size	Diameter
1 ml long	6.6 mm
1 ml short	4.7
2.5 ml	9.0
5	13.0
10	15.8
20	20.1
30	23.2
50	29.1

Suggested Force Level Settings for Common Syringes

Syringe Type/Material	Capacity	Force Setting	Common Manufacturer(s)
Plastic Syringes	≤5 ml	50%	BD plastic, Sherwood, Airtite, Terumo
	>5 ml	100%	
Stainless Steel	All	100%	KDS, Cole-Parmer
Glass/Glass	≤20 ml	30%	KDS Glass, Cadence (Popper)
	>20 ml	50%	
Glass/Plastic	≤1000 µl	30%	Hamilton, SGE
	≤5 ml	50%	
	>5 ml	100%	

KDS Legato 950 OEM Series User's Manual

kdScientific

APPENDIX B: LEGATO 950 & 952 OEM MIN/MAX FLOW RATES

Nominal Minimum/Maximum Flow Rates for Various Syringes. *(Actual Limits will vary depending on syringe manufacturer)*					
Syringe Size	*Syringe ID*	*Minimum Rate*	*Units*	*Maximum Rate*	*Units*
0.5 µl	0.103 mm	1.26000	pl/min	1.32611	µl/min
1 µl	0.1457 mm	2.52000	pl/min	2.65353	µl/min
2 µl	0.206 mm	5.10000	pl/min	5.30443	µl/min
5 µl	0.343 mm	14.1600	pl/min	14.7059	µl/min
10 µl	0.485 mm	28.2600	pl/min	29.4028	µl/min
25 µl	0.729 mm	63.9600	pl/min	66.4293	µl/min
50 µl	1.030 mm	127.680	pl/min	132.611	µl/min
100 µl	1.457 mm	255.480	pl/min	265.353	µl/min
250 µl	2.304 mm	638.940	pl/min	663.544	µl/min
500 µl	3.256 mm	1.27608	nl/min	1.32518	ml/min
1 ml	4.608 mm	2.55582	nl/min	2.65417	ml/min
1 ml	4.699 mm	2.65776	nl/min	2.76004	ml/min
3 ml	8.585 mm	8.87142	nl/min	9.21266	ml/min
5 ml	11.989 mm	17.3013	nl/min	17.9668	ml/min
10 ml	14.427 mm	25.0534	nl/min	26.0170	ml/min
20 ml*	19.050 mm	43.6821	nl/min	45.3622	ml/min
30 ml*	21.590 mm	56.1073	nl/min	58.2653	ml/min
60 ml*	26.594 mm	85.1297	nl/min	88.4040	ml/min

* Not available on Legato 952. These pumps work with 0.5 µl to 10 ml syringes

KDS Legato 950 OEM Series *User's Manual*

LEGATO 958 OEM MIN/MAX FLOW RATES

Nominal Minimum/Maximum Flow Rates for Various Syringes. (Actual Limits will vary depending on syringe manufacturer)					
Syringe Size	*Syringe ID*	*Minimum Rate*	*Units*	*Maximum Rate*	*Units*
0.5 μl	0.103 mm	0.54000	pl/min	596.496	nl/min
1 μl	0.1457 mm	1.14000	pl/min	1.19358	μl/min
2 μl	0.206 mm	2.28000	pl/min	2.38598	μl/min
5 μl	0.343 mm	6.36000	pl/min	6.61487	μl/min
10 μl	0.485 mm	12.7200	pl/min	13.2256	μl/min
25 μl	0.729 mm	28.7400	pl/min	29.8805	μl/min
50 μl	1.030 mm	57.4200	pl/min	59.6496	μl/min
100 μl	1.457 mm	114.900	pl/min	119.350	μl/min
250 μl	2.304 mm	287.400	pl/min	298.468	μl/min
500 μl	3.256 mm	573.960	pl/min	596.076	μl/min
1 ml	4.608 mm	1.14960	nl/min	1.19387	ml/min
1 ml	4.699 mm	1.19550	nl/min	1.24149	ml/min
3 ml	8.585 mm	3.99042	nl/min	4.14394	ml/min
5 ml	11.989 mm	7.78230	nl/min	8.08163	ml/min
10 ml	14.427 mm	11.2692	nl/min	11.7027	ml/min

APPENDIX C: EXTERNAL CONNECTIONS
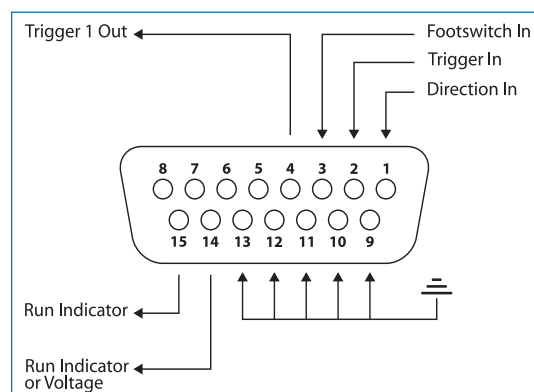
User I/O Connector Specifications

Pin Assignments

1. Direction control input

   Rising edge sets pump to infuse

   Falling edge sets pump to refill

2. Trigger Input

   Event trigger – falling edge triggers a program event

3. Footswitch Input (or Timer)

   Settable to work as:

   -Momentary switch closure to ground or TTL Logic Low; falling edge toggles between states (run/stop)

   -Starts on rising edge, stops on falling edge

   -Starts on falling edge, stops on rising edge

4. Trigger 1 Output

   TTL Logic Output-Default = Low Control thru program or serial comm

6. Sync Output

   TTL Logic Output –
   Rising Edge = Start Infuse
   Falling Edge= Start Refill

7. Direction Output

   TTL Logic Output –
   High = Refill
   Low = Infuse

9-13. Signal Return / Ground

14. Run Indicator Voltage

   +5V through a 470 ohm resistor (connect to LED Anode)

15. Run Indicator Output

   TTL Logic Output, active low (low = run) (connect to LED Cathode)

Electrical Specifications
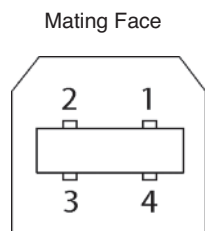
Inputs:	$V_{IH} \geq 2V$	$I_{IH} \leq 20\mu A$
	$V_{IL} \leq 0.4V$	$I_{IL} \leq 0.5mA$
Outputs:	$V_{OH} \geq 3.8V$	$I_{OH} \leq 6mA$
	$V_{OL} \leq 0.4V$	$I_{OL} \leq 6mA$

All Inputs are pulled high to +5 Vdc through a 10k resistor All Outputs are at TTL Logic Levels. Pulse duration should be 0.1s minimum.


Trigger 1 Out — Footswitch In, Trigger In, Direction In

8 7 6 5 4 3 2 1

15 14 13 12 11 10 9

Run Indicator

Run Indicator or Voltage

User I/O Connector Specifications

Utilizing the USB Interface

Mating Face

Pin #	Signal
1	+5V
2	- Data
3	+ Data
4	GND

USB VIRTUAL COMMPORT DRIVER INSTALLATION

When you connect the KDS Legato 950 OEM Series pump to a computer via USB for the first time, Windows will seek to install a driver for communication. The following section details the installation of the Virtual CommPort Driver supplied with the KDS Legato 950 OEM Series Pump.
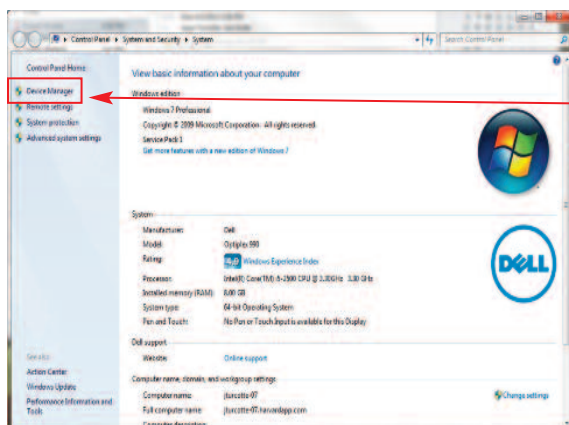

1. Connect the pump to the computer via USB. Open the control panel and select System and Security and then System. Click Device Manager on the left hand menu.
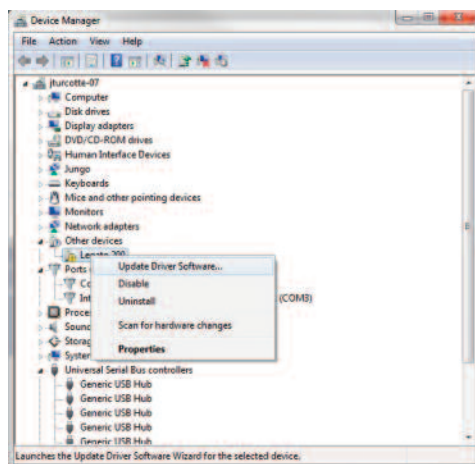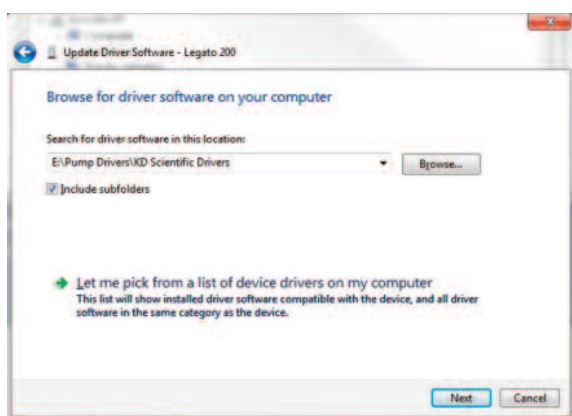

2. Two Flash Update Applications will be displayed in the device manager, under Other Devices. Right click on either of the flash update applications and select Update Driver Software.
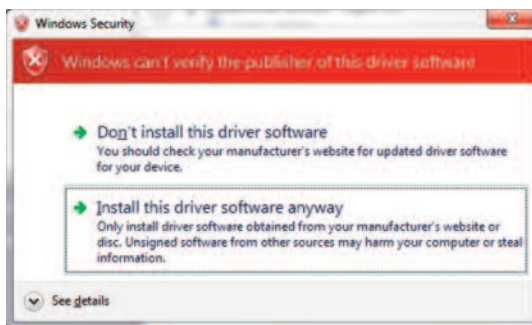
USB VIRTUAL COMMPORT DRIVER INSTALLATION (CONTINUED)
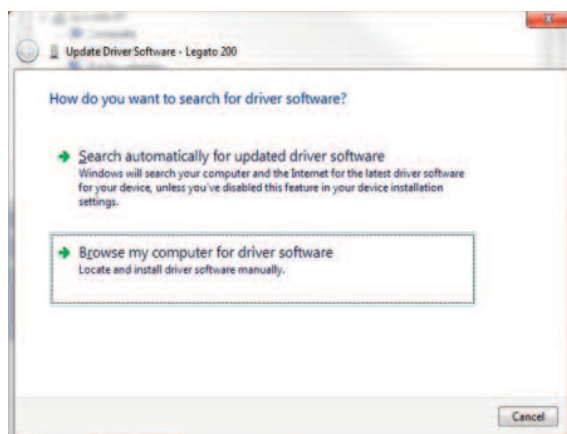
3. Select Browse my computer for driver software.

4. Click Browse and navigate to the pump drivers folder located on the CD supplied with the pump. Select the file KDS Scientific USB-CDC.inf. Make sure the Include Subfolders box is checked and then click Next.

5. If a warning message regarding the driver publisher is displayed, choose Install this driver software anyway.
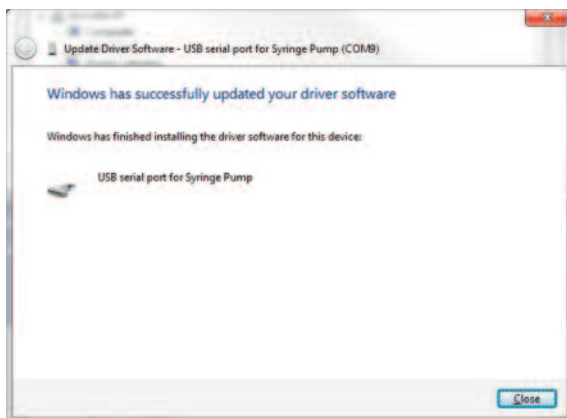
6. Click Close after the software has been successfully installed.

RS-485

> **CAUTION:** DO NOT CONNECT TO FIREWIRE PORTS ON A PC. DAMAGE MAY OCCUR TO PUMP AND/OR PC.

Mating Face

Pin #	RS-485 In Signal	RS-485 Out Signal	Notes
1	PWR IN	PWR OUT (+30V)*	* Protected by resettable fuse
2	GND	GND	
3	RS-485 A	TIED TO PIN 4**	** 100 Ω, ½ w to GND termination
4	RS-485 B	TIED TO PIN 3**	
5	TIED TO PIN 6**	RS-485 A	
6	TIED TO PIN 5**	RS-485 B	

RS-485 In/Out - IEEE-1394 Sockets
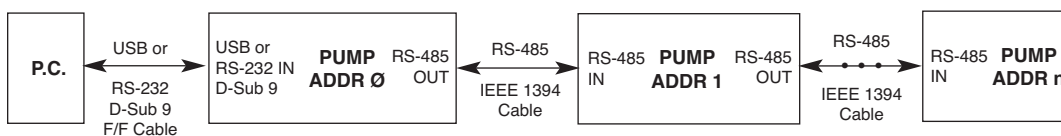
Daisy-Chaining via RS-485

RS-485 Dasiy Chain Connection Options:

- If all pumps have software versions 2.0.0 or higher, 99 pumps in chain.

- If all pumps have software versions 1.0.4 or lower, 99 pumps in chain.

- If mix of pumps with software version 1.0.4 or lower and 2.0.0 or higher, maximum of 5 pumps in chain and **1** RS-485 adapter (catalog # 78-8339) required.

> **NOTE:** *If a larger chain of pumps with mixed software versions is desired, pumps with software versions 1.0.4 or lower can be returned to manufacturer for a hardware update.*

> **NOTE:** *When applying power to pumps in a daisy chain, apply power to the last group in the chain first and work backwards.*

> **NOTE:** *When removing power, be aware that power removed from a stand-alone unit will cause power to be removed from all RS-485 powered units deriving power from that stand-alone unit.*

> **NOTE:** *Power may be removed from any group of pumps, except the first group, without affecting communications "downstream"*

> **NOTE:** *Each pump in the daisy-chain must have a unique address. The first pump must be set to address 00.*

APPENDIX D: MAINTENANCE

Maintenance

KDS Legato 950 OEM Series pumps require no special maintenance other than keeping them clean by avoiding accidental spills of pumped material.

The two guide rods and the lead screw should be sparingly lubricated every 100 hrs. The guide rods and the lead screw should be lubricated with Super Lube Synthetic Grease provided with the pump.

To clean the exterior surfaces, use a lint-free cloth to remove loose dust. For more efficient cleaning, use a soft cloth dampened [not soaked] with water, an aqueous solution of 75% isopropyl alcohol, or a mild detergent.

KDS Legato 950 OEM Series *User's Manual*

Upgrading Legato 950 OEM Series Software

> **NOTE:** *Prior to upgrading, users will need to install the KDS Legato 950 OEM Series USB driver as well as the bootloader driver file (KDS Legato 100 Series - Bootloader.inf). Reference "**USB Virtual Comport Driver Installation**".*

1. Upload the latest software version to your desktop (format is filename.srec).
2. Disconnect all I/O devices and then connect the pump to PC using a USB cable.
3. Using the Syringe Pump Communicator program, type 'boot' to enter "Boot Loader Mode".
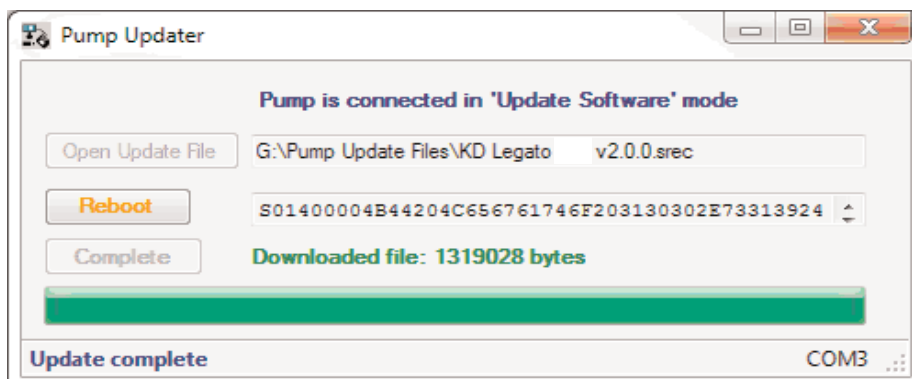
> **NOTE:** *To exit boot loader mode without upgrading the software, power cycle the pump.*

4. From the CD provided with the pump, open the Legato 950 OEM Series Pump Updater Application.
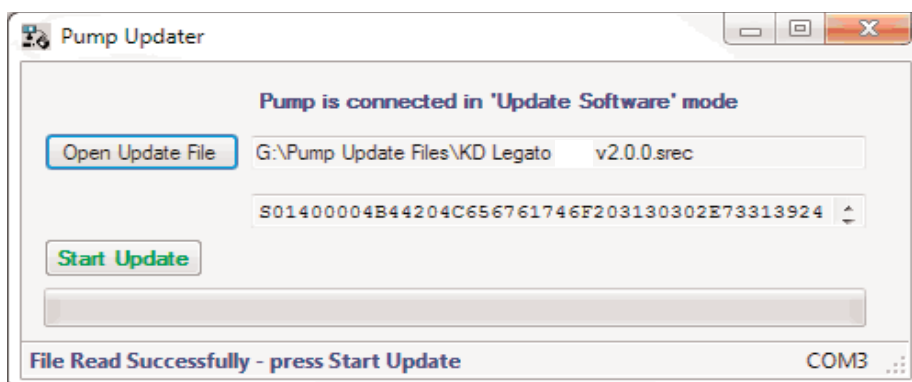
5. Click Open Update File and browse to the file previously saved on your desktop and click Open.
6. Click Start Update.

7. After the update is complete, press Reboot to power cycle the pump.

TROUBLESHOOTING

1. Infusion Accuracy

To ensure infusion accuracy always use new syringe(s) and measure syringe bore diameter and enter actual dimensions in millimeters (mm) using the Custom Syringe entry option. Additionally, make sure that the guide rods and lead screw are properly lubricated.

KDS Legato 950 OEM Series Display Error Messages

2. Motor Stalled

This indicates that the pusher block travel has been impeded. This may be caused by the syringe plunger hitting bottom, a kink in the tubing (occlusion), syringe plunger binding or any situation requiring more force to the head of the syringe than the pump is capable of delivering. To restart the pump, remove the cause of stalling and/or increase the force setting, then press RUN. The pump will continue the interrupted procedure where it stopped.

3. Out of Range

A value was entered or encountered in a pump program that was beyond the pump's limits.

4. Unit Won't Power Up

Verify the the Power Source Switch on the rear of the pump is set to DC-IN if powering through power supply or RS-485 if powering in a chain.
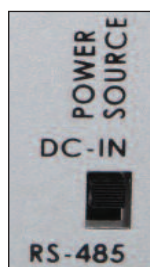
APPENDIX E: ORDERING INFORMATION

Item No.	Description

Model Versions

788950	Legato 950 OEM Module, Infuse/Withdraw, Programmable, Single Syringe
788952	Legato 952 OEM Module, Infuse/Withdraw, Programmable, Dual Syringe
788958	Legato 958 OEM Module, Pico, Infuse/Withdraw, Programmable, Dual Syringe

Accessories

788333	Auto Fill Valve Box Low Pressure
788336	Auto Fill Valve Box Medium Pressure
788338	Auto Fill Valve Box High Pressure
788332	Continuous Delivery Valve Box Low Pressure
788335	Continuous Delivery Valve Box Medium Pressure
788337	Continuous Delivery Valve Box High Pressure
788325	Anti Siphon Kit, Single Syringe
788331	Anti Siphon Kit, Dual Syringe
788304	RS485 Pump to Pump Communication, .5 m
788305	RS485 Pump to Pump Communication, 2 m
788306	USB Cable PC to Pump Communication, 2 m
788307	USB Cable PC to Pump Communication, 5 m
788326	Line Cord US 115 V, with Power Supply
788327	Line Cord European, with Power Supply
788328	Line Cord UK, with Power Supply
788313	Adapter D Sub 15 to Terminal Block
780225	Footswitch with Phono Jack Plug
788314	Adapter for 25 ml and 50 ml Hamilton Gastight Syringe
788315	Hex Key
788316	Lubricant SuperLube, 1 cc
788339	Adapter RS-485 (See Appendix C: External Connections)

KDS Legato 950 OEM Series *User's Manual*

Declaration of Conformity

Manufacturer: KD Scientific, Inc.
                           84 October Hill Road
                           Holliston, Massachusetts 01746-1388, U.S.A.
                           Phone: (508) 429-6809

We herewith declare that the following product:

Product Name: KDS Legato 950 OEM Syringe Pump Series
Model No.:   KDS Legato 950 OEM Series - Catalog # 788xxx

To which this declaration relates, is in conformity with the applicable EC Directives, harmonized standards, and other normative requirements:

Application of
Council Directive(s):   2006/95/EC   Low Voltage Directive
                            2004/108/EC   Electromagnetic Compatability Directive
                            2011/65/EU   RoHS Directive

Standard(s) to which
conformity is declared:

  Safety: EN 61010-1:2001 (2nd Edition)
  Emissions/Immunity: IEC 61326-1 Ed 1.0 (2005-12)
                           IEC 61000-4-2:2001
                           IEC 61000-4-3:2002
                           IEC 61000-4-4:2004
                           IEC 61000-4-5:2001
                           IEC 61000-4-6:2003
                           IEC 61000-4-8:1993+A1:2000
                           IEC 61000-4-11:2004
                           IEC 61000-3-2:2000
                           IEC 61000-3-3:2002
                           CISPR11:2003+A1:2004, Group 1, Class B

EMC and Safety compliance were evaluated by Intertek/ETL Semko

Reference test report
file numbers: 100179785 Box -001, -003, -005a, -005b
                           100602821 Box-001, -001A

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

Place: United States of America
Date: April 02, 2012

CE

kdScientific

_____
(Signature)

Beth Bauman
(Full Name)

VP Engineering / Operations
(Position)